Light and Lighting

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International Forum

As this issue of *Light and Lighting* is published the International Illumination Commission is in session in Stockholm. Many aspects of the subject of lighting are being discussed, technical information is being exchanged and delegates from many lands are meeting together to pool ideas and to strive for common agreement in some of the matters of lighting upon which international agreement is desirable. Great Britain is particularly well represented at this twelfth session of the Commission, and about one fourth of the technical papers presented are by authors from this country. Our own National Illumination Committee, with its numerous specialist sub-committees, has been most active in preparing and contributing material for discussion in this international forum. There is also another international body concerned with light—the Comité International de la Lumière, under whose auspices meetings for the presentation of reports and scientific papers are to be held in Paris later this year. We shall give some account of these international meetings in due course: we have no doubt they will be fruitful.

Notes and News

Lighting Opportunities

"All experience goes to show that the frontiers of artificial lighting are advancing with every improvement in light sources and equipment, but it has been made abundantly clear that lighting, without proper development, can settle down at an artificial level of saturation determined not by what people ought to have and could have, but by what they are accustomed to." This was one of the opening statements in a paper by Mr. W. Robinson at the recent Sales Management Conference of the British Electrical Development Association, held in London towards the end of May. The author went on to say that of all uses of electricity lighting provides the best opportunity for creating good will by service but that, in spite of this, the average consumer of electricity receives less help in lighting matters than in other fields. Though the general trend of better lighting and high levels of illumination hardly seems to us to indicate that we are likely in the near future to "settle down at an artificial level of saturation" throughout the whole field of lighting applications, we fully agree that there is a great need for the electricity boards to take a far greater interest in lighting matters and, particularly in view of their constant and direct contact with consumers, to take steps to bring home to the public the advantages of better lighting. It was obvious from the discussion that followed the paper that there are many in the supply industry who fully support this view.

In warning of a low saturation point no doubt Mr. Robinson had in mind the ordinary domestic consumer whose ignorance of lighting matters is truly appalling. In spite of the activities of such bodies as the Lighting Service Bureaux and the E.A.W., we doubt if one domestic consumer in 100 has any idea what kind or size of lamp he should use for any particular job. Nor is such ignorance confined to those coming within what are called the lower income groups; we have spoken with quite a number of people who have both reasonable incomes and reasonable intelligence who declined to change a 15-watt lamp for even a 25-watt as they fear that such a step would make a terrific difference to their quarterly account.

The problem is how to get elementary lighting knowledge over to the consumers, whether domestic, industrial, or commercial. Mr. Robinson made a number of suggestions, including special displays with promotional literature at the service centres, and the organisation of staff with a knowledge of lighting. The question of training of suitable staff was fully discussed following the presentation of the paper. It was suggested that the lighting engineers employed by manufacturers should be regarded as specialists in their own particular equipment but that electricity board staffs should be trained to give general advice. It was also pointed out that in the domestic field there was a great opportunity for female members of the staff to specialise in lighting. The same speaker, Mr. Hewitt, of Manchester, also pointed out that in their continuous contact with consumers the service centres had a great opportunity to find out what the consumers themselves wanted, a matter too often overlooked in these days of recommendations and codes of practice.

On the matter of more specialised

training of lighting engineers, Mr. W. G. Chilvers said that the supply industry had not given the support it could give to the City and Guilds courses, which are arranged by many of the technical colleges, and he suggested that if the younger men in the industry could be encouraged to take these courses the boards would then be able to build up the qualified lighting staffs they required. This view was warmly supported by other speakers, who also endorsed the appeal for greater support to the I.E.S. We, of course, heartily agree, and hope that these enthusiasts will be able to drive home their views with advantage. Mr. Robinson, in the course of his reply to the discussion, was kind enough to make some reference to this journal and to suggest that as a first step towards training their staffs the boards should ensure that a copy of *Light and Lighting* went to every service centre. We couldn't agree more. One board at least already does this.

Birthday Honours List

The King's Birthday Honours, published on June 7, included the names of no fewer than four I.E.S. members. Dr. H. W. H. Warren, formerly Director of Research of the B.T.H. Co. and now Managing Director of Associated Electrical Industries, received a knighthood. Dr. Warren has presented or been otherwise connected with a number of papers on lighting research and development and it will be remembered that he gave a paper on this subject to the I.E.S. in 1939. Recipients of the C.B.E. included Dr. W. R. G. Atkins, of the Marine Biological Laboratory at Plymouth, who gave a paper on his work on the penetration of daylight into the sea to the I.E.S. in 1945, and Mr. L. Howles, Chairman of the South Wales Electricity Board. A particularly pleasing award is that of the O.B.E. to Dr. J. W. T. Walsh, whose election to Honorary Membership of the I.E.S. was announced in our last issue.

We are sure that all our readers would wish to join with us in congratulating the recipients of these honours.

Colour in Ceramics

Although colour is an important property of most ceramic products—tiles, pottery, chinaware, etc. — scientific methods of colour measurement and analysis have been used hardly at all in the industry. This point was made by Dr. A. Dinsdale, of the British Ceramics Research Association, in a recent address to the Colour Group. Dr. Dinsdale explained that the colour of a ceramic product depended on the surface colour of the base material (biscuit), the body colour of the glaze and the decorative colour which might be applied above or below the glaze. The interest was in the final colour as modified by the several firings which the product had to undergo. Colour analysis had to be based principally on measurements of the reflected light, in which the specular reflection from the glaze was a complicating factor. Dr. Dinsdale discussed the relation between the hue and saturation of the final colour and the concentration of the pigment and the glaze thickness and showed how calculations based on the C.I.E. specification of colour and the supplementary data on smallest perceptible colour differences would enable pigment mixtures to be chosen which would yield the required constancy of the product given the known variability in glaze thickness, etc. One specially interesting consumer requirement was mentioned: in addition to a maximum tolerable colour difference between different samples there was in some cases a most desirable colour difference which was not zero. Thus it was not aimed at producing coloured tiles of identical colour because the aesthetic effect of slight variations in, say, a tiled fireplace was preferable. In addition to their use in researches on improved colouring of the product colorimetric methods should lead to a more rational description of ceramic colours for sales purposes.

Night-time view of the Royal Festival Hall seen from the river.

The Royal Festival Hall

The Royal Festival Hall has been described as "monumental" by some and less politely by others. The fact remains that it is the only permanent building on the South Bank site and that it contains one of the largest and most interesting post-war lighting installations.

The lighting of the Royal Festival Hall was conceived as an integral part of the architecture of the building rather than on the lines of a more orthodox system employing individual fittings. This is especially true of the auditorium, where both stage and general lighting are treated in this manner, the former being largely housed in the acoustic canopy and the latter in special coves and recesses comprising the architectural treatment of the ceiling. The whole of this lighting is operated by remote control from a console situated in the auditorium and is controlled by power-operated dimming equipment housed at roof level. The scope and provisions for stage lighting are such that productions from symphony concerts to open stage ballet and opera can be presented.

The lighting treatment of the foyers has also been the subject of considerable co-operative planning by the architect and chief engineer. Other notable features include the staircase lighting and the large louvred ceiling over the sunken foyer. This latter fitting is one of the largest of its kind and contains over 300 fluorescent lamps. The electrical installation, including the lighting, was designed by the chief engineer of the London County Council, in conjunction with Mr. Robert Matthew, the architect to the L.C.C., and Dr. Leslie Martin, deputy architect.

The Auditorium

By the use of G.E.C. cold cathode tubing in continuous runs of 92 ft. 6 in., a source of indirect illumination is provided that is concealed from the audience, but is apparent in the even lighting of the whole ceiling as well as of the hall itself. This indirect lighting is supplemented by some 150 tungsten lamps in G.E.C. louvred reflectors recessed in the ceiling, which provide additional direct light for the seating area. From the auditorium these direct-light sources appear little brighter than the rest of the ceiling area because of the general level of illumination of their surroundings provided by the cold cathode tubes. The colour of the cold cathode tubes is warm white in order to give full value to the warmth of tone of the interior woodwork and red leather acoustic panelling.

The ceiling is formed with a series of coves, each shaped so as to conceal a run of cathode tubing and to direct the light from it forwards and upwards on to the area between itself and the next cove. The tungsten lamps are recessed in the portions of the ceiling between each pair of coves. Eight of the coves span the whole width of the hall, and there are two shorter coves, one on each side of the auditorium, at the rear of the building. Further runs of tubing are recessed in the ceiling under the gallery, making a total length in the hall of 3,000 ft.

All the lighting is controlled by dimmers, which may be operated to give a "wave" effect, the lights being dimmed in sequence from the rear of the hall so that the impression is given of a shadow sweeping across the hall until the whole auditorium is in semi-darkness. Simultaneously the stage lighting is brought up to its full brightness.

The Concert Platform

Since an acoustic soundboard hangs over nearly the whole of the concert platform and choir, all lighting had to be projected vertically through apertures in this. Thirty-three 1,000-watt 26-deg. floods, most of them 40 ft. or so up, are used for this purpose. The lanterns can be brought into use separately so that the coverage may be adjusted to suit the size of the orchestra and/or choir, or even restricted to a single soloist.

Unlike any other hall of this kind, provision has been made in advance for the dramatic productions which will inevitably

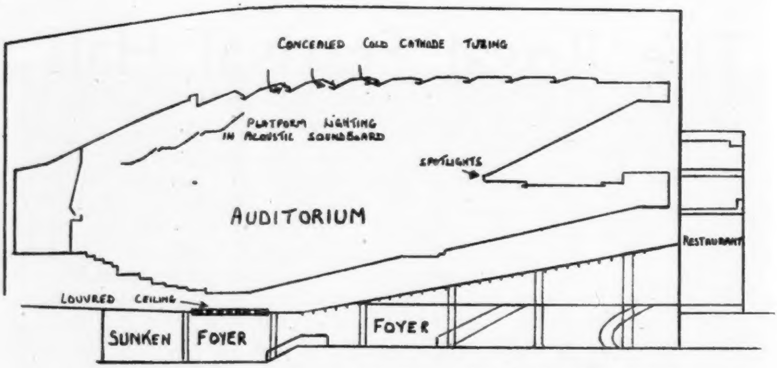


Fig. 1. Diagrammatic section of the Hall showing positions of main lighting features.

Fig. 2. Louvred ceiling in sunken foyer.

Fig. 3. Combined tungsten and fluorescent lighting in the main foyer.

Fig. 4. Louvred ceiling at head of one of the main staircases. Beyond is one of the main promenades.

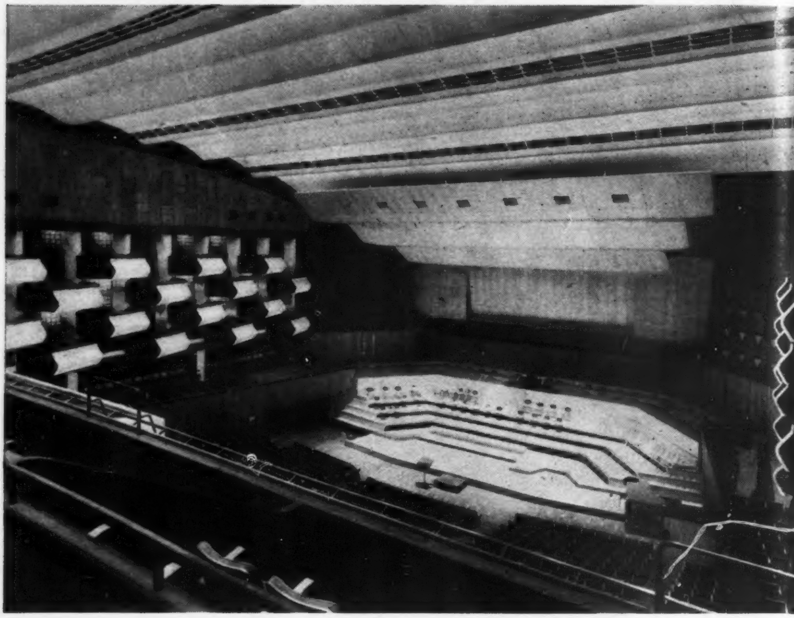


Fig. 5. View of the auditorium.

be staged in an auditorium with such good viewing conditions as this; a season of ballet, for example, has now begun.

Production on an open stage, without a proscenium and with little, if any, scenery puts a greater burden on the lighting as the sole means of suggesting atmosphere and effect. The London Council Council and engineers of the Strand Electric and Engineering Co., Ltd., working in close co-operation, have provided the basic equipment for this purpose plus permanent wiring where additional apparatus, hired to suit a particular production, may be placed. Control apparatus to cover both permanent and temporary equipment has been installed.

Additional apertures for stage lighting in the acoustic soundboard can be opened up; and there are also 11 apertures in the walls on either side of the auditorium behind which run concealed lighting galleries. A built-in housing with spotlights is constructed on the balcony front and projection rooms at the rear of the balcony contain four high intensity arc projectors.

To make the maximum use of the minimum number of lighting apertures, the basic equipment included 32 1,000-watt spotlights and 23 1,000-watt narrow angle floods each fitted with four colour and white remote

Fig. 6. Type of fitting used in the promenades.

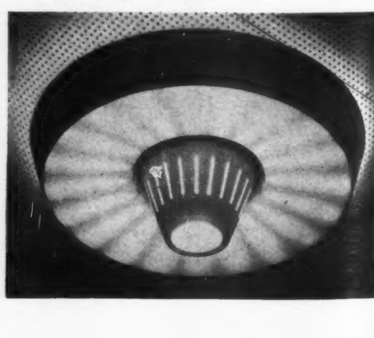


Fig. 7. View of the auditorium from the concert platform.

colour-filter change mechanisms. The concert lighting floods can also be fitted with colour filters and used for dramatic work. The acoustic soundboard being somewhat difficult of access, all lanterns there are wired as separate circuits and terminate in a plug board in the dimmer room off-stage where they can be grouped at will for control purposes.

There are 84 dimmers for dramatic productions and these (plus the colour-filter change mechanisms) are remotely controlled from a distance of 200 ft. by a Strand Light Console desk situated in a small room at stalls level giving a good view of the stage. In addition to this lighting, the console operates 16 dimmers for the auditorium lighting. Eleven of these are special units each dimming a ceiling cove of 33 cold cathode fluorescent lamps. These dimmers are particularly noteworthy since they give, probably for the first time in a public building, a brightness range of 600 to 1. The other auditorium lighting is by tungsten lamps.

Other Features

Other interesting lighting features are to be found in the main and sunken foyers and in the lighting of the grand staircases. The main foyer, as will be seen from the illustration, has a sloping ceiling which is indirectly lighted by means of some 400 4-ft. fluorescent lamps of a special colour designed to blend with the light from 400 flush-mounted louvred reflector fittings each of which contains a 60-watt tungsten lamp. The resulting illumination is between 12 and 14 $lm/ft.^2$ The sunken foyer which is all part of the same space as the main foyer though on a slightly lower level, is lighted in the main from a large louvred ceiling measuring 90 ft. long by 30 ft. wide. This accommodates 224 fluorescent lamps and gives an illumination of 40-45 $lm/ft.^2$.

The lighting of the main staircases is effected by means of continuous louvred fittings let into each side of the stringers of the stairs. Fluorescent lamps are alternated with tungsten lamps on the D.C. secondary circuit.

Brightness Terms

It is apparent that for some time there has been uneasiness regarding lighting terms in current use. The interesting problem of brightness engineering has brought into prominence the inadequacy of certain terms used in this country.

By R. R. HOLMES, M.Sc., A.C.G.I.
(Registered Lighting Engineer, I.E.S.)

Phraseology, as emphasised by Sir Ernest Gowers in his admirable booklet, "Plain Words," may be drawn up either to be readily understood or, alternatively, to be unambiguous: this is a notable distinction. Phrases designed to be unambiguous, suitable enough in a legal document or a fundamental definition, are usually too cumbrous for the rapid communication of ideas. To be truly clear the words chosen must readily call to the reader's mind the idea concerned, and as far as possible give it form and dimensions. This choice of terms in connection with the sciences and their application is a subject of prime importance—once a poor or inadequate term is introduced there is always the danger of it becoming too readily accepted to the detriment of other and more explicit terms, either already available or subsequently proposed. Such importance is attached to this matter in the field of lighting that the International Commission on Illumination has at present under consideration a review of illumination terms for the purpose of obtaining the maximum possible co-ordination in this subject.

In mechanical or electrical engineering the terms concern determinable quantities related to the basic, accepted standards of Mass, Length and Time. The metric system is most commonly favoured for fundamental science, but as soon as applied engineering is reached it is necessary to interpret the ideas in terms of the units of Mass and Length in use in the country concerned; unless this were done the practical craftsman could not successfully be set to work.

Lighting engineering, however, falls into a special category, for only some of the fundamental terms such as *candle-power, lumen, reflectance,* have exact (although arbitrary) meanings, but other terms, such as *brightness* and *colour,* are largely dependent for their interpretation on individual sensations in the human brain. The definition of these latter terms in physical or electrical terminology enables us to reproduce the cause of the effect when required, but does not tell us the nature and value of the sensation produced, which may vary for different individuals, or for the same individual under different conditions, or at different times. In lighting engineering, therefore, the words to be effective must at once call to mind the idea concerned, and be precise whenever possible—more must not be expected of them.

The human judgment is frequently called for in the application of lighting, and lighting matters are often a subject of consultation between the lighting expert on the one hand and his lay client on the other, each of whom has every right to record his reaction to the visual conditions under consideration. Thus clarity of expression is essential if ideas are to be conveyed and exchanged, and the clumsy, unambiguous phrase must be kept in the background, to be used only when simple terms fail to make the proper meaning clear.

Apart from energy considerations, applied lighting involves measures of length and area, and, just as in other branches of applied engineering, these must be stated in terms of the standard units adopted for the country concerned. In France, where length

is measured in terms of the metre and its sub-divisions, the unit of illumination is the lumen per square metre (named Lux); while in England and America, where the foot is the standard of length, the corresponding unit of illumination is the lumen per square foot (or foot-candle). This latter name, which is inclined to be looked at askance from some quarters, serves a very useful purpose—it conveys at once to the mind an image of the effect concerned because the "candle" and the "foot" are already familiar objects. No one has seen a *lumen,* and the phrase "lumen per square foot" consequently calls no image to mind: there are few, however, who have not seen a candle or at some time or other seen the illumination produced by such a source at a distance of a foot. The measure will not be exact, but it is the basis of a very positive visual idea.

The use of names for the terms and units in applied engineering is already a common practice—the term "Head" in hydraulic engineering is a typical example —and the extension of names in illuminating engineering is justified wherever the quantity or "rate" or unit concerned is in such constant use that a short name will assist in quickly conveying the idea.

The subject of brightness is of the highest importance in applied lighting, and it is in this connection that certain terms and names are proposed by the writer, firstly to clarify the ideas on the subject, and secondly, to give names to those quantities in most frequent use. For the reasons given above it appears, however, *quite impossible for applied brightness terms to be international*: they are irrevocably dependent on *area,* which, in applied engineering, must be expressed in the units common in the country for which they are being proposed.

The word "brightness" in the English-speaking world has been used in general to refer sometimes to a mere pinpoint of light, sometimes to a large luminous area, and sometimes to the psychological effect produced by a number of bright surfaces presented to the view: as a result of this, the word calls up more than one image to the mind, and therefore its meaning is not always clear.

There is no doubt of the confusion that has arisen, and a solution to the difficulty may be sought along one of several possible lines. One of these lines, followed by an eminent authority (1) in the United States, makes use of entirely new terms (*pharos, helios,* etc.), to which precise meanings are given to depict the ideas it is intended to convey. Another line, taken at a recent meeting of the International Commission on Illumination, was to accept a term, "luminance" (4) for the physical cause of the sensation of brightness, and a term "luminosity" for the corresponding sensation itself; both terms, although unfamiliar, have an obvious etymological connection. Another approach, however, would appear to be the examination of our normal vocabulary for words such as "*brilliance,*" which are correctly used in everyday speech to refer to the ideas we have in mind, although they may seldom before have been associated with a scientific quantity.

This word "*brilliance,*" apart from brief references by Amick (2) and Boast (3), where it is used for the physical sensation caused by brightness, seems to have received little attention. Yet from our earliest days we have all understood what is meant by phrases such as the "brilliance of a diamond," and even when the word is used in other contexts it is nearly always associated with the characteristic conception of some part strongly outshining other parts which form its immediate background: a brilliant performance, a brilliant reflection, a brilliant speech, are typical phrases we hear every day.

The writer suggests that the two most important types of brightness be distinguished by using terms as follows:—

Brilliance to refer to pin-point sources and luminous areas subtending a small angle (say, less than, perhaps, 1.5 deg.) at the eye.

For example: The carbon arc, the tungsten filament, part of an opal glassware fitting, a pearl lamp.

Brightness to refer to extended sources and luminous areas subtending a considerable angle (say, more than, perhaps, 1.5 deg.) at the eye.

For example: A window, a wall surface, a large luminous panel.

The dividing line is not intended to be a sharp one, but merely to indicate the classification concerned. A small area in a large luminous surface may be the subject of investigation, when its properties might well be discussed under *Brightness* or *Brilliance,* according to whichever best expressed the idea under review.

The normal unit of brightness of sources subtending a small angle of view, is, in this country, the candle per square inch, but it is without a name. The brightness of surfaces subtending a large angle of view on the other hand is expressed in terms of a

perfectly diffusing surface giving out so many "lumens per square foot." The existing name for this latter unit is the "foot-lambert"—a name which has little to commend it other than considerable usage: it calls nothing to mind, and its two roots, "foot" and "lambert" originate in the vocabularies of different countries, the latter word *by itself* being the name of the brightness unit adopted in France (of one emitted lumen per square centimetre).

As names for the units of *Brilliance* and *Brightness* the words "*Bril*" and "*Bry*" are put forward owing to their visual and their aural conection with the property to which they refer. The corresponding symbols might conveniently be "B_l" and "B_y" which have a direct relation to the usual symbol "B," which at present is often made to do duty in every case. Thus an arc would be described as: "of so many *Bril*" (instead of the cumbrous "candles per square inch") and a large area of window would be described as: "of so many Bry" (instead of the present hybrid foot-lambert).

Such a usage might help us to shorten our phraseology with advantage, and there would be no confusion as to the particular conception of brightness at any moment under consideration. The conversion of quantities from one form to the other would be carried out in exactly the same way as it is executed at the present time.

It is true that the International Commission on Illumination has, recently, accepted the terms *Luminançe* and *Luminosity* for referring to the actual brightness (photometric) and the visual brightness, respectively, of any primary or secondary source of light, and these terms are excellent for laboratory purposes, but they do not indicate whether brilliance or brightness is the conception under consideration.

In conclusion a comparative table is given in which these suggested terms may be compared with some common terms in the British and Metric systems.

The author wishes to make acknowledgment to Messrs. Crompton Parkinson, Ltd., for permission to publish this article.

Some British and Metric Brightness Terms

Quantity	British				Metric			
	Term	Symbol	Unit	Name of Unit	Term	Symbol	Unit	Name of Unit
A.—TERMS IN COMMON USE :—								
Brightness (photometric)	Luminance[4]	B or L	c/in²	None	Luminance[4]	—	c/cm²	Stilb
			lm/ft²	Ft. Lambert			lm/cm²	Lambert
Brightness (sensation)	Luminosity[4]	B	c/in²	None	Brilliance[4]	—	c/cm²	Stilb
			lm/ft²	Ft. Lambert			lm/cm²	Lambert
B.—AUTHORS' PROPOSED TERMS :—								
Brightness (sensation)	*Brilliance*	B_l	c/in²	*Bril*				
	Brightness	B_y	lm/ft²	*Bry*				

(1) "Brightness and Helios," by Parry Moon and Domina Eberle Spencer, Trans. I.E.S. Sept., 1944, Vol. XXXIX, No. 8. (2) Fluorescent Lighting Manual, by Amick, 1942. (3) Illuminating Engineering, by Boast, 1942. (4) Light and Lighting, Vol. XLII, No. 6 (1949), p. 156.

Belgian Code of Practice for Street Lighting

The following article reviews the draft code of practice for street lighting recently issued in Belgium and prepared by a committee under the chairmanship of Monsieur André Boereboom, of the Ministry of Public Works.

Just about 12 months ago we published an account of the street lighting code prepared in France under the authority of the Ministry of Reconstruction and Town Planning (*Light and Lighting*, June, 1950, p. 221). We have now received a copy of a similar code prepared under the auspices of the Belgian National Illumination Committee and circulated for comment by the Institut Belge de Normalisation. Street lighting is at present undergoing very rapid extension and development in Belgium, as readers will have learned from the article by M. Boreboom published in *Light and Lighting* for August last. The committee actually responsible for the present code is a very large one, with no fewer than 55 members representing all the organisations, official, professional, scientific or technical and commercial which are concerned with street lighting and, in fact, the document has evidently been prepared with careful regard to all aspects of the problem. For instance, it is pointed out more than once that, while a certain course may be the best from the purely technical point of view, economic considerations often dictate the adoption of a less ideal solution. This is brought out, too, in the preamble, where it is specifically stated that the document is a code of practice and not a specification; in other words its provisions are not a set of rules to be applied rigidly in every case, but a collection of recommendations to be adapted to local conditions with a due regard for economic considerations.

Legal Obligation

It is interesting to note that in Belgium there is a legal obligation on each commune to maintain good street lighting in every town and village. As regards the main thoroughfares connecting the centres of population, it is pointed out that good lighting can relieve traffic congestion during the day by spreading the load over the whole of the 24 hours. The further suggestion is made that the lighting of such inter-urban thoroughfares should be distinct in character from the local street lighting in the towns through which they pass, so that the lighting may serve as a guide to the driver who is unfamiliar with his route.

The first two chapters of the code are devoted to general matters and to definitions. The third is a discussion of the factors affecting visibility on the street, with particular reference to silhouette vision, the effect of the state of the street surface and the " fight against glare."

Photometry

The fourth chapter is concerned entirely with the photometric measurements needed in street lighting technique. It is pointed out that, while the need for achieving pronounced contrasts would seem to call for measurements of brightness, this is a subjective phenomenon which is not strictly tied to its physical analogue, luminance. Further, measurements of luminance are not very conveniently made, with the result that the quantity most commonly measured in street lighting practice is illumination.

Under the heading " recommended values " there is a table giving, for four groups of roads (classified mainly on the basis of traffic), both the mean illumination and the uniformity factor, i.e., the ratio of minimum to maximum. This table is accompanied with the remark that illumination values should not be used as criteria of good street lighting; nevertheless, under normal conditions it is considered that the tabulated values are always necessary, though not

always sufficient for the attainment of a satisfactory result.

Classification

The question of classification of roads, always a thorny subject, is dealt with in Chapter V. There are two main classes of thoroughfares, one comprising motor-roads (autostrades) and inter-urban roads, the other including all roads in built-up areas, divided into three classes according to the amount of traffic carried. Under present conditions motor-roads need not be lighted while inter-urban roads should be lighted well or not at all. In the main streets of towns a high value of illumination is desirable so that objects may be seen by direct vision as distinct from silhouette. Where the traffic is less congested lighting for silhouette vision is suitable, while for very lightly trafficked roads the illumination is designed mainly for the convenience and safety of pedestrians. The third main class comprises open spaces and squares, bridges, parking places, tunnels, etc., all of which have their own peculiar requirements. In particular the grading of the illumination near the entrances of road tunnels is recommended. This may be achieved either by a reduction of the daylight immediately before the entrance is reached, or by providing higher artificial illumination immediately inside the entrance.

Light Sources and Light Distribution

The sixth chapter consists mainly of a table giving the principal characteristics of the various sources of light at present in common use for street lighting. The next chapter, an important one, deals with the choice of suitable fittings, particularly as regards their light distribution. The characteristics of the three types, "cut-off," "non-cut-off" and "semi-cut-off" (the English names are used) are described in a way which is very reminiscent of the draft British code of practice.

Arrangement and Mounting

The next two chapters are concerned respectively with posts and other means for mounting the lighting fittings, and with the arrangement of the sources on plan. Cable suspension of fittings receives lengthy consideration, and in addition to the types of arrangement common in this country, two others are included, termed respectively "bi-axial staggered" and "bi-axial opposite." These are exaggerated cases of side mounting with overhang; it is recommended that the overhang should not exceed one-fifth of the width of the carriageway. Mounting heights of between 26 and 32 ft., spacings of between 65 and 160 ft., and spacing-height ratios of 3 for cut-off and 4 to 5 for non-cut-off distributions are recommended. The special treatments needed for dual carriageways, for curves and bends, road junctions and roundabouts are subjects of a series of recommendations which, in general, follow the same lines as in the British draft code of practice. One of the final paragraphs of this part of the code is worth quoting. It reads as follows: "The art of the lighting engineer consists in achieving the best compromise between the principles of good lighting and the limitations imposed by local conditions. In order to obtain this, a detailed study of the site should be made on a large-scale plan and on the site itself, and the first consideration should be the requirements of important thoroughfares and danger spots. What is needed is not a strict adherence to a uniform spacing of the lanterns but an adaptation of the general recommendations given in the present code to each particular case as it arises."

Hours of Lighting, Maintenance, etc.

Chapters X and XI of the code are brief. The former discusses the conditions under which all-night lighting at full intensity is required, and when reduction of intensity or total extinction may be justified. A plea is made that, immediately prior to total extinction, some warning should be given to drivers by a previous partial reduction or partial extinction. Chapter XI, on maintenance, gives very little guidance on this important subject, though it is mentioned that a control may be applied by making periodic measurements of illumination, "always under the same conditions." the lighting of signs is briefly treated in Chapter XII, and supply systems and methods of control are discussed at rather greater length in Chapter XIII. As in the case of the French code, overhead supply is not uncommon on account of its simplicity and much lower cost. Remote control is advocated for important installations.

The very complicated subject of cost is dealt with in Chapter XIV in more detail than is usual in a lighting code of practice, and it is pointed out that what is needed is a compromise between expenditure (including both capital and running costs) and all the factors included under the heading "psychological considerations." These are such matters as the colour of the light, the nature of the surroundings, and the aesthetic appearance of the installation. The final chapter gives a brief outline of the information which should be supplied to anyone

tendering for a scheme and the details which any tender should include.

Photometry Again

It was mentioned earlier that in the chapter dealing with the values of illumination recommended for different classes of roads, the tabulated figures were for (a) mean illumination, and (b) ratio of minimum to maximum. It is well recognised that to determine the mean illumination over a roadway is a matter of considerable difficulty and usually necessitates a large number of measurements. The appendix to the code, after some hints on the use of photoelectric illuminometers, describes a recommended method of finding the mean illumination by making measurements at nine points distributed over a section of the carriageway and six points over a section of the footpath. Such a scheme is probably satisfactory for arriving at an approximate figure, but if it were applied to check compliance with a rigidly specified value there would be endless opportunity for argument and disagreement among the experts.

In conclusion, it may be said that the whole document is a very workmanlike and useful code of practice for street lighting, and it should do much to ensure that the large amount of money now being spent on the improvement and extension of public lighting in Belgium is spent to the best advantage.

Correspondence

To the Editor, LIGHT AND LIGHTING

Brightness Engineering

Sir,—Ward Harrison's summary of modern researches on glare (LIGHT AND LIGHTING, December, 1950) demonstrated that there was essentially agreement between the various investigations. It therefore appeared reasonable to propose a recalculation of Harrison's Glare Tables on an agreed experimental basis, to replace the present empirical basis. Dr. Harrison readily agreed to this proposal, and as a result several workers on glare problems are to meet at Stockholm to consider what this agreed experimental basis should be. Mr. Lowson, in Australia, would appear from his letter to you to have a major contribution to make to this discussion, and I have invited him to participate in the work if he is able.

I hope that this evidence of initiative on the part of the investigators themselves to rationalise their data in a practical form will reassure Mr. Lowson that we are indeed alive to the practical as well as to the fundamental significance of our studies. I suggest that it is not always right to charge the research worker with a lack of appreciation of the designer's problems. Not all experimenters are content to "arrive at a formula as a satisfactory end-product." Does not the "practical man" himself fail in his responsibilities? Does he always understand his own problems? It is rare that an investigation results from a clear statement of a problem from a "practical man." Usually it derives from the logical development of the philosophical outlook of the research worker himself. The experimenter not only solves the problems, he is forced, through lack of guidance, to pose them himself, in a form suitable for a comprehensive investigation. Clearer thinking from the "practical man" in developing problems for investigation seems to be at least as necessary as the need for the presentation of experimental data in a form suitable for immediate use by the designer. The whole matter is one for collaboration. Real harm has been done by the concept of the experimenter as a "backroom boy" remote from reality, and the responsibility for the misconception lies at least as heavily on the practical man as on the investigator.

Equally, in the presentation of the results of a research, the engineer and designer should accept the responsibility of stating clearly the form in which the data would be of most use to them. In our own paper, Petherbridge and I devoted considerable space to an analysis of the practical implications of our studies, and we gave tables and worked examples in illustration. Much more is required if the results of research are to find ready application, but it is essential that those in close touch with design problems should indicate the precise nature of the guidance that is required.—Yours, etc.,

R. G. HOPKINSON.

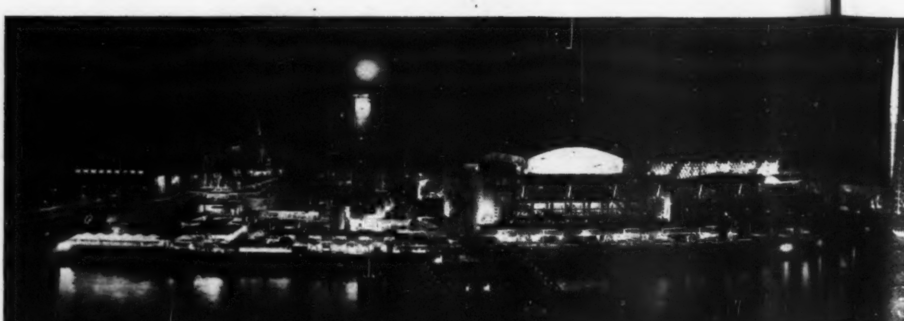
Building Research Station,
Garston, Watford, Herts.

Festival Lighting

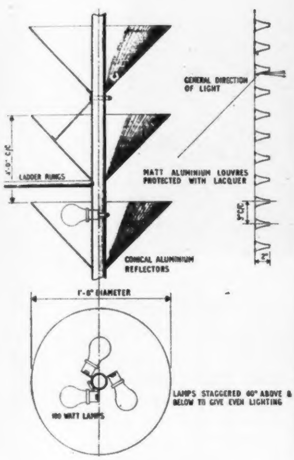
To publish pictures of every building in the country which has been floodlit for the Festival would take up all our paper allocation for this year and the next. On the other hand the following pictures are not restricted to the South Bank Exhibition if only because one of the greatest attractions of the exhibition at night is the view of the north bank.

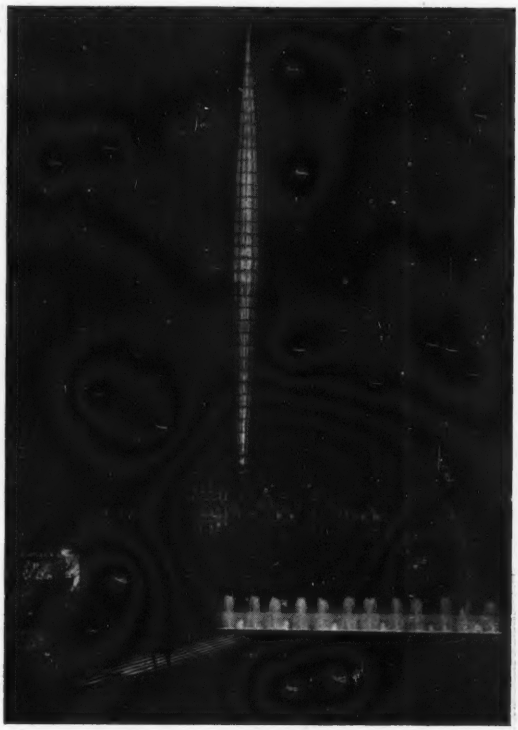
There are buildings which are regularly floodlit on occasions such as this but it is interesting to note that instead of clinging to old methods new equipment and methods have frequently been used with even better effect than of old. Illustrations 1, 7 and 9 are Ministry of Works photographs, Crown copyright reserved.

2. *St. Martin-in-the-Fields with illuminated flower beds in Trafalgar Square in the foreground. The church spire is illuminated by a combination of long and medium range floodlights.*



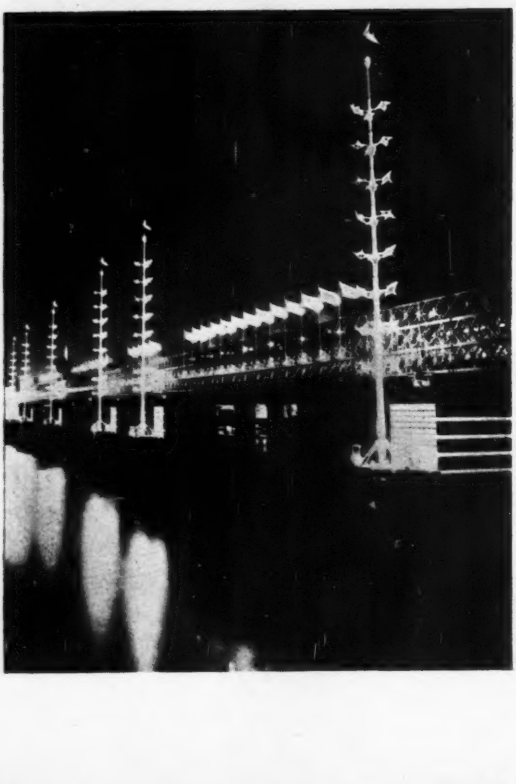
1. *Panoramic view taken at night of the Thames from Waterloo to Westminster, which has become one of the most impressive sights of London in this Festival year.*





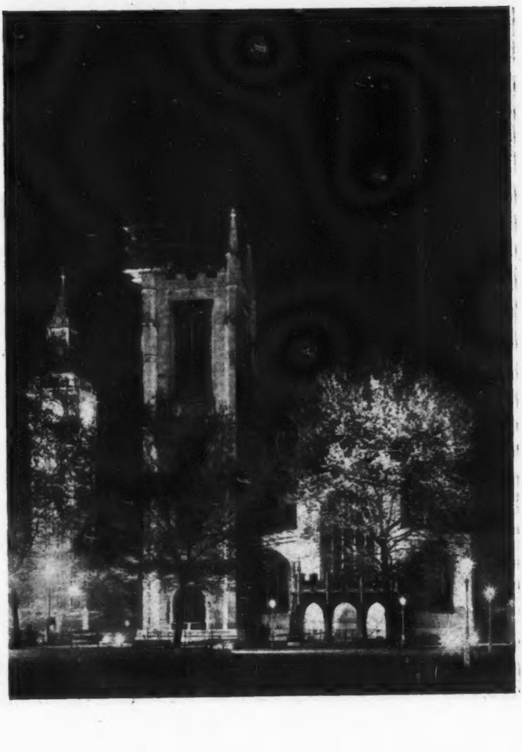
3. The illuminated "Skylon" attracts attention to the South Bank for miles around. Also seen in the photograph are the lights sunk into the main concourse and the illuminated fountains with the floodlit buildings on the north bank in the background. The diagram shows how the "Skylon" is lighted from the interior. The "Skylon" was designed by Moya and Powell and built by British Insulated Callender's Construction Co. Ltd.

4. A general view of one section of the South Bank Exhibition taken from the main concourse looking to the east. The York Road screen, floodlit by B.T.H., is seen on the right.



5. The Bailey Bridge leading from the Embankment entrance on the North Bank to the exhibition. The lighting by Ediswan includes the spinners and stars which are lighted by concentrating floodlights at the foot of the masts. The flags are lighted by 23 floodlights.

6. A general view of the Downstream sequence, where the exterior lighting was arranged by Siemens. Included in the view are the sections on Sport and the Seaside and one of the landing piers.



7. St. Margaret's, Westminster, with Big Ben in the background. The church is illuminated with a combination of long, medium and short range floodlights; the fittings in the doorway have light amber colour screens.

8. *No floodlighting scheme in London would be considered complete unless it included the Houses of Parliament. This picture also shows the beams from three searchlights in the Horse Guards Parade.*

9. *The attractiveness of the South Bank Exhibition at night is considerably increased by the very skilful flood-lighting of the buildings on the north bank. Whitehall Court, shown here, is illuminated with ten 5-kw, long-range projectors focused only on the upper parts.*

10. *The Waterloo station façade in York Road and the Festival Lion floodlit by the G.E.C.*

11. *Under floodlights, Windsor Castle stands out clearly for miles around. The Round Tower and other towers are lit with sodium lamps and the remainder with tungsten lamps. The result is most effective. The installation was supplied by the B.T.H. Co. as a contribution to the Festival.*

School Lighting in Sweden

By GUSTAF HASSEL

Following our recent series on school lighting, we have received some comments from Sweden giving details of recommendations by the Swedish Lighting Association on lighting in schools.

In the autumn of 1947, Ljuskultur (the Swedish Lighting Association) began the publication of a series of pamphlets under the heading "Good Lighting." The first pamphlet was "Good Lighting in the School." This has now appeared in its third edition, revised in the light of recent experience and bearing in mind fittings now available.

The recommendations in this pamphlet are based on the following requirements. It should be mentioned that school classrooms in Sweden are usually of the standard dimensions, 6.5 by 8.5 metres, with a ceiling height of 3.5 metres and with windows on one of the main walls. The requirements are:—

(1) As most of the work in schools is performed in daylight, the seating should be arranged so that daylight comes from the left.

(2) The artificial lighting should be arranged so that the direction of the light and shadows are the same as in daylight.

(3) The lighting should be equally good on all desks with a minimum of 150 lux (15 lm./ft.^{2}).

(4) Glare should be avoided, bearing in mind that it may be direct or indirect through reflections on the surface of the desk, on glossy papers on the desk or on the blackboard. (Incidentally, blackboards have now been replaced by green ones, which give better seeing conditions.)

(5) The colour of the light should be considered with the illumination level to give pleasant and comfortable lighting.

(6) The fittings should be easy to keep clean and not too expensive.

The best arrangement to meet these

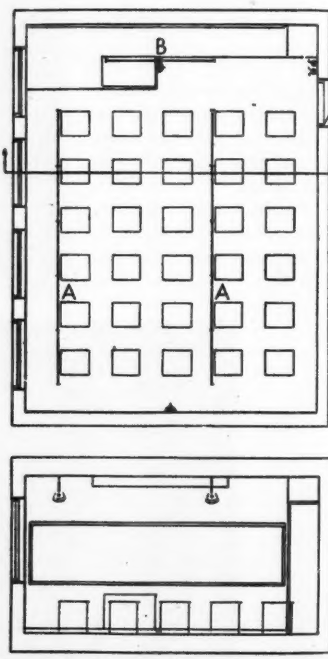


Fig. 1. Plan and section of classroom with fluorescent lighting according to Swedish recommendations. The desks are lighted principally from the sides. Fittings are attached directly to the ceiling when this is lower than 3 metres, and in other cases suspended by pendants. (A—room lighting fittings. B—blackboard lighting fitting.)

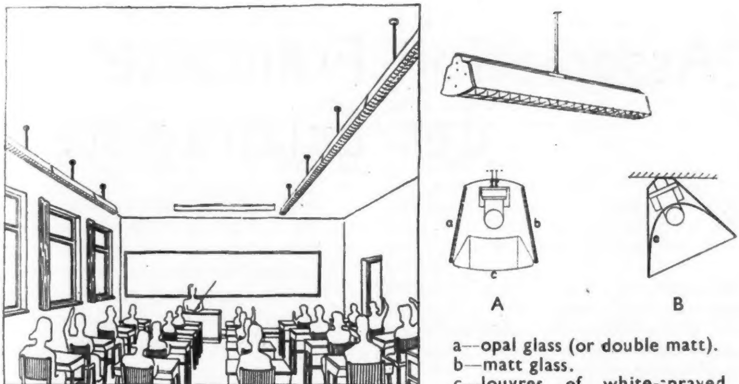


Fig. 2. Sketch of the classroom shown in Fig. 1 with cross-sections of the general lighting fittings (A) and the blackboard fitting (B).

a—opal glass (or double matt).
b—matt glass.
c—louvres of white-sprayed sheet-iron length and crosswise.
e—polished aluminium.

requirements as far as possible is shown in Figs. 1 and 2. Altogether, 12 white 40-watt lamps are required, including two for lighting the blackboard. The ceiling is white and the walls are painted in a light colour. The desks and other furniture have a light and rather matt surface.

On the whole, this arrangement is found to give very good lighting. However, two objections can be raised. One is that the use of glass in the fitting can cause accidents. Consequently the glass should be replaced by a suitable plastic with a rather high reflection factor, very good diffusion and small loss of light. Plastics are, however, still too expensive in Sweden. Another expedient is to make the whole fitting of sheet-iron. Such fittings are now used (Fig. 3), but light loss from them is rather high. A third solution is to retain the glass but to protect it as far as possible by suitable construction of the fitting. Such a fitting, which is now in use in many schools, is shown in Fig. 4.

The other objection to this method of classroom lighting is the risk of reflections on the desks and papers, if the children look too far to either side. The horizontal angle of vision free from reflected glare, is, however, quite sufficient for their normal work, if the fitting has the recommended shielding angle of 45 deg.

"Tulamp" ballasts or connecting the lamps on different phases is recommended to avoid risk of flicker. An advantage from the installation point of view is that only three outlets are required in the ceiling.

Of course there are also other methods of solving the problem of lighting in schools which may give even better results as regards brightness distribution in the room and freedom from glare, but the arrangements described above have much to recommend them on economic grounds and are now used in Sweden to a great extent.

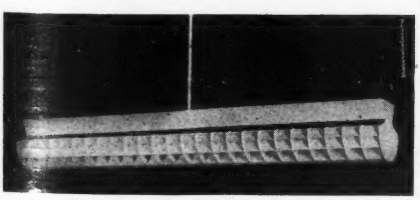


Fig. 3. Fitting made of white-sprayed sheet-iron.

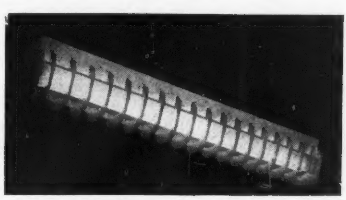


Fig. 4. Fitting with some protection of the glass side against accidents.

Association Française des Eclairagistes

The recent annual meeting of the A.F.E. in Paris almost took the form of an international meeting as lectures were given by a number of visitors from other countries, including two from Great Britain.

The conference was divided into four sessions, dealing respectively with light sources, physiology of vision, lighting fittings and installations. Each session had a different chairman who summed up the conclusions reached after the papers had been read and discussed. A luncheon and a lecture by Monsieur M. Lods, an architect, on "Architecture and Light" preceded the conference.

Light Sources

This session was opened by Monsieur Henri Maisonneuve, who gave a general report on the year's progress. There was little new to British engineers as far as tungsten filament lamps were concerned, although internally silvered reflector spotlamps are now being made up to 300 watts. In the fluorescent field, however, some interesting differences in technique were noted. For example, where filament lamp ballasts are used, it is the practice to use two krypton-filled lamps in parallel with each other in series with a 40-watt fluorescent lamp. These lamps are run at full brightness, so that the maximum light-output is achieved; the advantage of the two lamps is that if one fails the fluorescent lamp does not go out but merely functions at reduced brightness. French engineers do not consider it necessary to lengthen the light of the filament ballast lamps by under-running them, as they say that the replacement cost is negligible. Also demonstrated in this session was a fitting housing three fluorescent lamps, one on a capacitive, one on an inductive, and the third on a resistive circuit, by which means stroboscopic flicker was completely eliminated. Another interesting development was a starter switch incorporating a cut-out which operated when a worn-out lamp started to blink, thus saving damage to the choke due to excessive current. A paper by Monsieur Waguet on flash discharge lamps was of considerable interest, though, again, there appeared to be little difference between French and British practice. Monsieur R. Gluntz presented a paper describing the new technique of electro-luminescence. This phenomenon is scarcely out of the laboratory stage, but the paper provoked great interest. An interesting discussion ensued during which one member of the audience remarked that the discussion reminded him of the early days of fluorescent lamps when everyone raised all the objections to them they could think of; it would be interesting to see how this new light source developed in the future.

Physiology of Vision

After a paper by Mr. A. A. Kruithof, describing the conditions necessary to produce the best seeing conditions, taking into consideration both illumination values and glare, Dr. V. Ronchi delivered a paper on optics. After the verbal hors d'oeuvre of Dr. Ronchi, Dr. R. Hopkinson's paper on glare and contrast made a solid and satisfactory meal. Since this paper followed very closely that which he delivered to the I.E.S. in London last year,* it is not summarised here. It was followed with great interest and gave rise to a lively discussion. Particularly impressive were the demonstrations employed and the film showing the actual methods used to arrive at the conclusions in the paper.

Lighting Fittings

The second day opened with a most lucid and detailed talk, on the role of fittings in a properly designed installation, by Monsieur Cadiergues. He sketched the main outlines of the new technique of brightness engineering, and described the researches of Harrison and Meaker, Luckiesh and Guth in the United States, Vermuelen and de Boer in Holland, and Petherbridge and Hopkinson

* I.E.S. Transactions, Vol. 15, No. 2, 1950.

in this country. It was not only necessary to limit the brightness of fittings themselves, but to consider them in relation to their surroundings. A great deal of research had been made on this problem, and it was possible to deduce general rules, but sufficient results were not yet available for a reliable statistical survey to be produced. A factor which had to be taken into consideration was the variability of individuals—and not only to the difference between one person and another, but to the variation in the reactions of the same people to the same conditions at different times of day, and even on different days of the week. It seemed, too, that it was more important to consider people who were ultra-sensitive to glare, rather than to produce rules which applied to the average individual.

These studies, he said, had already given the following results:—

(i) Vertically mounted tubes are more glaring than horizontal ones.

(ii) End-shields are practically useless in industrial fittings.

(iii) Well-designed specular reflectors are better than matt reflectors.

(iv) Fluorescent lamps and fittings ought to be placed parallel to the main axis of the room, except for louvred fittings which should be placed transversely.

(v) Indirect lighting can be uncomfortable.

(vi) The general impossibility of producing a high-quality lighting scheme of more than 4·5 lm/ft^2 with bare fluorescent lamps.

One could also arrive at certain quantitative conclusions such as the correct diameter for diffusing spheres or cylinders in relation to their light-output.

One could say, therefore, that brightness engineering made it possible to choose lighting fittings judiciously and that it should soon be possible to produce a method of applying these ideas to different lighting schemes. One could predict that many installations are, and will be, totally unsatisfactory from this point of view. Economy in lighting fittings could be just as dangerous as economy in the size of lamps.

Monsieur R. Pagès followed with a description of technical advances in the materials and design of fittings.

The first part of the afternoon session was devoted to two discourses, by Monsieur Viénot and Monsieur Domin respectively, on the aesthetics of fittings design. The substance of their remarks, which in Monsieur Domin's case were illustrated with slide films of fittings of curious, though often very attractive, design was that the advent of fluorescent lamps imposed new conditions on the designers of fittings who, hitherto, had been able simply to adapt traditional forms to modern light-sources. This was quite permissible as long as the source of light remained concentrated, but the appearance of line sources posed altogether new problems and demanded a totally new approach to the problem of illumination. It was no longer possible to apply outmoded decorative motifs to new types of fittings, and it was necessary for designers to adopt a totally new point of view.

This gave rise to a lively discussion, the audience being fairly evenly divided between the moderns and the traditionalists. It was interesting to hear put forward points of view with which one is becoming more and more familiar in this country.

Installations

The final session consisted of a most interesting description by Mr. L. C. Kalff of the lighting of the new Vroom en Dreesmann's store at Rotterdam, a description of the lighting of the Royal Festival Hall, the House of Commons, and Beverley Minster by Mr. R. L. C. Tate, of the Lighting Service Bureau of London, and a review of interesting lighting installations in France by Monsieur R. Nampon.

Describing the Dutch installation, the first speaker emphasised how in natural lighting, and in the best painting, attention is drawn to the principal subject by means of colour, brightness and line. In most large stores, the relationship between these three factors is such as to attract attention *away* from the object of prime importance—the goods displayed, and direct it to the ceiling, the floor, and the lighting fittings themselves. The new installation was designed to reverse this procedure, and also to be sufficiently flexible for the lighting to be arranged where it was needed and to be changed at will to suit rearrangements of counters, showcases and displays.

This was achieved by use of a dark blue ceiling which did not attract attention to itself, beneath which was suspended a metal grid on which could be rested louvred fittings incorporating fluorescent lamps with filament lamp ballasts. In addition to these fittings, which could be very easily moved from one place to another, there were a number of very concentrating filament spotlamps in special housings, which could also be plugged in wherever convenient. In certain positions, such as along the walls and near the escalators, permanent lighted counter and wall showcases were provided.

Recent Street Lighting Installations

Birmingham

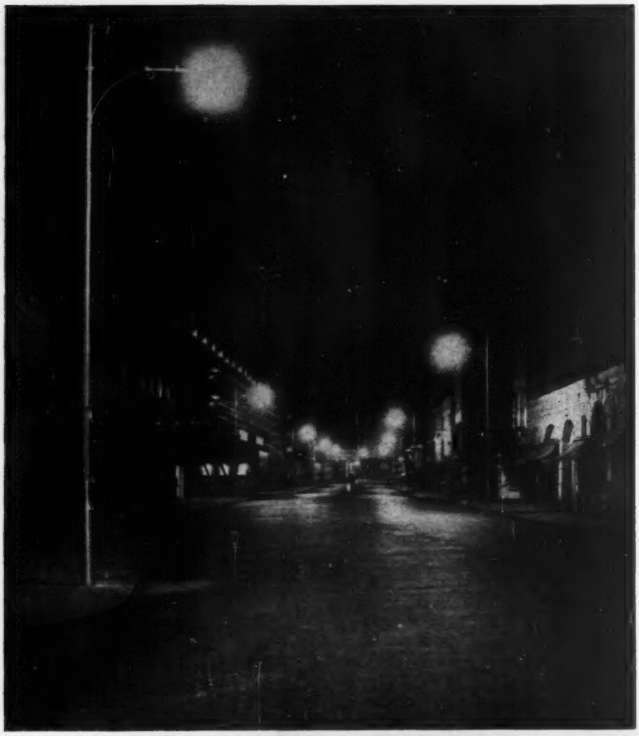
A re-lighting scheme in the centre of Birmingham makes use of the Revo lantern incorporating four vertical 80-w. 5-ft. fluorescent lamps. The lanterns are mounted on Revo fluted cast iron columns, the top of the lantern being 21 ft. above the ground. Two views of the installation are shown on this page.

Oxford

Cowley Road, Oxford, is an important road leading from the town to an industrial area and at peak periods carries a large volume of traffic. A new installation includes 35 B.T.H. lanterns, each housing three 80-w. 5-ft. fluorescent lamps.

Newcastle-on-Tyne

The Great North Road, on the outskirts of Newcastle-on-Tyne, has recently been relighted with Metrovick "S.O. Fifty" lanterns using 140-w. sodium lamps. The lanterns are fitted to existing trolley-bus poles and have been found very suitable for withstanding the severe vibration and shock encountered under these conditions.



Lambeth

Amongst other improved lighting schemes in the vicinity of the South Bank Exhibition is that in York Road, where Holophane "Acorn" bowl refractors, fitted with 1,000-w. tungsten lamps, have been installed.

Macclesfield

The Stockport-Potteries road at Macclesfield has recently been re-lighted by the N.W. Electricity Board. Fluorescent lamps are used in the town centre and sodium lamps on the approach to the town.

I.E.S. ACTIVITIES

London

Those members who assembled in the lecture theatre of the Royal Institution on Tuesday, May 8, for the annual general meeting enjoyed a most interesting lecture by Professor E. N. da C. Andrade, the Director of the Institution. The lecturer held his audience spellbound, not only by his delightful presentation of a subject which was by no means new to many of them, but equally by the series of striking and original demonstrations he had taken great trouble to prepare. Light, he said, was normally produced by heat, but there were certain ways in which it could be obtained from cold bodies, and he extolled the glow-worm as a most skilful lighting engineer who could produce light with an efficiency of 576 lumens per watt, i.e., some 90 per cent. of the maximum theoretically possible.

After the glow-worm, Professor Andrade mentioned the firefly and various luminous organisms, all of which provided examples of bioluminescence. Next he touched on chemi-luminescence, in which light was emitted as the result of chemical action, and showed the beautiful luminous effect produced by bubbling ozone through a solution of luminol. In fluorescence and phosphorescence, however, no chemical action was involved, but light was emitted from a gas, liquid or solid, as the case might be, when it was exposed to visible or ultra-violet radiation. Many substances showed the effect and of those demonstrated perhaps the most striking was a bottle of tonic water (containing quinine). The now familiar phosphorescent posters, said Professor Andrade, were printed with an ink consisting of a coarsely ground phosphorescent material incorporated in a thermo-setting plastic.

The lecturer then went on to describe the laws governing the phenomena of phosphorescence. In the first place, he said, the rate of decay of the brightness followed in some cases the law applicable to a monomolecular chemical reaction and in others that governing a bimolecular reaction, and he demonstrated how the rate could be measured in any particular case by means of the phosphoroscope.

Professor Andrade's next demonstration was of a fact well known to many of his audience, but seldom so strikingly shown experimentally He projected an intense spectrum on a plate of phosphorescent material and showed that when the light was cut off the only part of the plate which glowed was that which had been illuminated by light from a certain region of the spectrum. In this way he proved Stokes' law that, generally speaking, the wavelength of the light emitted was greater than that of the exciting light. He also showed how the radiation from a mercury discharge in a tube could excite fluorescence only if the tube transmitted ultra-violet radiation.

Another phenomenon demonstrated was the temporary "flash-up" and subsequent extinction of phosphorescence when a material which had previously been excited by ultra-violet radiation was exposed to long-wave infra-red rays. Again Professor Andrade used the intense spectrum from an arc to show conclusively which spectral region was responsible for the effect. Somewhat analogous was the emission of light by fluor-spar (pre-exposed to ultra-violet radiation) when it was heated on a hot plate. Even more striking was a metal cylinder coated on the outside with a phophorescent material. This was exposed to u.v. and the phosphorescence was allowed to die down. Boiling water was then poured into the cylinder and immediately a glow spread upwards from the bottom; this quickly died away so that a band of brightness gradually travelled up the cylinder as the water was poured in.

A seemingly opposite effect was the release of stored-up phosphorescence when a silver halide, previously exposed to u.v. when at room temperature, was cooled to the temperature of liquid air. It was then seen to glow brilliantly for a time, and a similar effect was shown by a tube of mercuric iodide when it was dipped into a vessel of liquid air.

Most of the remainder of Professor Andrade's lecture was devoted to a discussion of the theories which had been put forward to explain the various phenomena he had described and demonstrated. He emphasised the importance of very small quantities of an "impurity," the presence of which as an "activator" in the "matrix" of the principal material was essential to the production of phosphorescence. It appeared that when radiation was absorbed certain of the electrons in the material were raised to higher energy levels and on their

return to their original state gave out most of the extra energy in the form of light. In solids the energy levels were somewhat ill-defined and could be better described as bands.

Years ago Lenard had put forward the theory that the presence of the impurity, or activator atoms, disturbed the crystal structure of the matrix and produced new energy levels. As a result of excitation certain electrons became "trapped" in these higher energy levels and only escaped according to a probability law. If thermal energy were supplied to a material in this state the escape of these trapped electrons was speeded up and the phosphorescence was increased temporarily, but, of course, this had to be paid for by a subsequent reduction, owing to the smaller number of electrons which remained "trapped" and therefore capable of emitting light. The theory of the release of stored light by exposure to very low temperatures was more complicated, involving the assumption that electrons could move from one energy level to another without the emission of light.

In conclusion Professor Andrade mentioned some of the applications of fluorescence and phosphorescence, pointing out that for certain purposes a long, or moderately long, after-glow was needed, while for others, such as a television tube, this was a great disadvantage, and what was then required was a substance in which the period of after-glow did not spoil the definition of moving objects in the picture.

At the conclusion of the lecture, a vote of thanks, proposed by Dr. H. Buckley, a past president of the Society, and seconded by Dr. W. D. Wright, was carried by acclamation.

Birmingham Centre

The last sessional meeting of the Birmingham Centre was held on April 20, 1951. It was a joint meeting with the Association of Public Lighting Engineers. An audience of upwards of 130 people were present when Mr. E. Stroud led off a discussion on the recently issued Code of Practice for Street Lighting.

He mentioned a paper given many years ago which described suitable light distribution curves and recommended a spacing height ratio of 4 to 1. The new code came very close to this with a recommended spacing height ratio of 4.8 to 1 for non cut-off lanterns and 4 to 1 for cut-off lanterns on Class A roads. The chief trouble with high-angle sources was glare, and the use of cut-off type lanterns seemed the best method of attacking the problem, even though it meant an increase of 20 per cent. in the number of fittings used.

Mr. Crawford Sugg then continued the discussion and suggested that only general guidance could be given in a Code of Practice as street lighting was a job for the expert and it was virtually impossible to lay down hard and fast rules. For Class A roads lanterns with an output of from 2,750 to 7,000 lumens per 100 linear feet were specified, the lumen output to be mainly in the lower hemisphere; most demands, he said, seem to be met with an output per lantern of 3,000 to 4,000 lumens. He said he knew of many main roads where a first-rate Class B scheme, using the full 15-ft. mounting height and efficient modern lanterns would be perfectly satisfactory. He also mentioned that he would like to hear opinions on the switching off of street lighting at midnight, and also the colour of the illuminant, neither of which are mentioned in the Code.

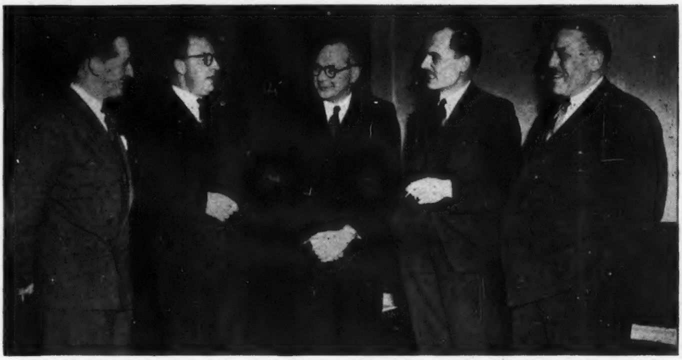
Mr. Howard Long said that it was more important that one should be able to see than to have a high brightness on the roadway. Glare was a fundamental problem, and should be prohibited for street lighting as it was for factory lighting. He also expressed the opinion that all street lighting equipment should be totally enclosed. Mr. Hartill suggested that the cut-off lantern was unsuitable for staggered lighting and it was agreed that the medium angle-type of lantern was probably more suitable.

A vote of thanks was proposed by Mr. Horsfell and was seconded by Mr. Raymond.

Liverpool Centre

The Liverpool Centre held their annual luncheon at the Adelphi Hotel, Liverpool, on May 7, when over 130 members and guests were present. This annual function is usually favoured by the presence of the Lord Mayor of the city, but on this occasion he was indisposed and unable to be present. His place was, however, taken by the Deputy Lord Mayor, Alderman J. J. Cleary. Other guests of the Centre included the president of the Society, Mr. L. J. Davies, Mr. G. A. S. Nairn, M.B.E., chairman of Lever Brothers (Port Sunlight), Ltd., and representatives of the I.E.E., the Liverpool Architectural Society, the E.C.A., and the Director of Education for Liverpool.

The toast of the "City and Port of Liverpool" was proposed by the president, and during the course of his remarks he referred briefly to some of the outstanding features



Liverpool Centre Luncheon (left to right). F. J. Burns, Hon. Asst. Secretary. T. D. Woods, Chairman, Liverpool Centre. L. J. Davies, President, I.E.S. D. St. C. Barrie, Vice-Chairman, Liverpool Centre. K. R. Mackley. Hon. Secretary.

of the city. The reply was made by the Deputy Lord Mayor.

Mr. G. A. S. Nairn then gave an address, the theme of which was the human factor in industry. He referred to the importance of good lighting, saying that it was an easy matter to make out a good case for efficient industrial lighting on the grounds of greater quantity and quality of production alone, but the further factor to which more and more importance is being attached as time goes on is the effect which lighting conditions have on the employees of industry. He said that human beings may have to work like machines, but they could not be treated like machines; their frame of mind had a considerable influence on the work they turn out.

Mr. Nairn also outlined some of the important influences of electrical development on industrial expansion and social conditions during the last century. He also urged the recruitment and training of the best staff available and for more consideration to be given to staffing problems.

Mr. T. D. Wood, the Centre chairman, thanked the Deputy Lord Mayor and the president for their attendance, and in his expression of thanks to Mr. Nairn he made one or two witty references to the fact that he was associated with the famous firm of Lever Bros., firstly by saying that the Centre were in "Lux" way in having such an eminent speaker, and that whilst he had indeed paid tribute to artificial light sources in his address, it was apparent that Mr. Nairn favoured "Sunlight."

Sheffield Centre

At the March sessional meeting of the Sheffield Centre, Dr. J. Ward, head of the Mechanical Engineering Department, Huddersfield Technical College, gave a lecture entitled "Engineering Applications of Polarised Light." The speaker surveyed the development of polarised light from the year 1812, when Sir David Bruster observed that when polarised light was passed through a loaded beam made of glass a stress pattern was obtained due to double refraction. The pioneer of this photo-elastic method of stress analysis was Professor E. G. Coker, of University College, who, in his extensive researches, used "Nicol" prisms and models made of celluloid. To-day, the photo-elastician uses "Polarois" screens and transparent plastics, which are more streeoptically sensitive than celluloid.

Dr. Ward explained how the methods of polarisation could be used for preventing dazzle from motor-car head lamps, for cutting out reflections in photography, for stereoscopic projection in the cinema, and for generally preventing light glare.

A vote of thanks to Dr. Ward for the very interesting evening was proposed by Mr. Benson and seconded by Mr. Dick.

On the occasion of the April meeting, the Centre was privileged to hear Mr. W. R. Stevens, B.Sc., who is both a Vice-President and a Fellow of the Society. He gave an informal talk on "Some Aspects of Illuminating Engineering," covering the basic design of lighting fittings and the more practical problems related to maintenance, effects of weathering and dissipation of heat, etc. The lecturer dealt with elementary principles of reflector design, effects of specular reflection and refraction, the use of parobolic reflectors, including incandescent lamp filament design. To conclude, a film and lantern slides were shown, illustrating principles of lighting design and their various applications.

REVIEWS OF BOOKS

"Modern Fluorescent Lighting," by A. D. S. Atkinson, A.M.I.E.E., F.I.E.S., Technical Editor, Lighting Service Bureau, London. George Newnes, Ltd., London. Price 15*s.* 159 *pp.* 64 *illustrations.*

It would appear that the author's original intention was to bring his earlier book, "Fluorescent Lighting," up to date, but owing to the great strides which have been made it was found necessary to rewrite most of the book, retaining only that part dealing with fundamentals.

Most people when speaking of fluorescent lighting mean what the more technically minded would call hot cathode fluorescent lighting. It is, however, necessary to differentiate between hot and cold cathode, and the use of the general term for the title of this book is likely to be misleading. True, some four pages out of a total of 154 pages of text are given to cold cathode tubes, but in effect the book is concerned only with hot cathode lamps.

The book deals with the characteristics of the lamps in some detail, with illumination design, fittings and applications of fluorescent lamps. There is also a chapter on the pros and cons of fluorescent and tungsten lighting. Some useful appendices are given. It is interesting to compare the illustrations of installations in this book with those in the author's earlier book published in 1944; they show that the lighting engineer has learned quite a bit in that time on the application of this still comparatively new light source.

The author obviously disapproves of the term "lumen per square foot," as he uses the older term of "foot-candle" throughout the book. G. F. C.

"Colour," Dyestuffs Division, Imperial Chemical Industries, Ltd. 120 *pp.*

When an organisation has allowed to be published over a period of years accounts of investigations by members of its staff it is often a highly satisfactory procedure if these various publications can be brought together under the covers of a single volume. If at the same time the papers represent important contributions to a particular subject the fact that they are becoming available in a single volume is of added value.

This is most certainly the case in the collection of papers now published under the title "*Colour*" by the Dyestuffs Division of Imperial Chemical Industries which includes investigations in the field of colour physics and colour psychology carried out in the laboratories of the Dyestuffs Division of Imperial Chemical Industries during the period 1940 to 1948.

The opening paper, by White and Vickerstaff, was originally presented as a Mercer Lecture to the Society of Dyers and Colourists and gives a useful survey of the subject of colour and colorimetry.

Naturally most of the remaining papers have a direct relation to the dyestuffs industry, but each one of them has a wider significance. Particularly interesting is the one entitled "Colour Harmony," by Clarkson, Davies and Vickerstaff, which is appearing for the first time in the present volume.

There is no doubt that all those interested in the subject of colour or its measurement will wish to have this book in their library and it should certainly form part of the collection of reference works of teaching institutions dealing with advanced physics.

J. N. A.

POSTSCRIPT

By "Lumeritas"

The use of artificial lighting for horticulture is not new but it is an application about which we seldom hear. The recent annual report of the John Innes Horticultural Institution refers to experiments which have yielded valuable information concerning the beneficial effect of artificial illumination upon the health and vigour of seedling plants which results in earlier maturing and heavier yields. One wonders whether earlier maturing implies a shorter life or a longer prime, or whether the use of artificial illumination results also in the prolongation of plant life.

Among recent letters to the editor of the "Evening Standard" I noticed the following:—"It is difficult to reconcile the wrath of the Bevangelists against the charge for spectacles with their serene indifference to the retention of the tax on light. The heavy purchase tax on electric lamps must act as an encouragement to save light at the expense of sight." This business of taxing light is certainly deplorable, and this is not the first time it has been done. In great-grandfather's days there was a window tax, and after that a now forgotten Chancellor of the Exchequer proposed to make a little profit out of light by taxing matches.

A very interesting publication entitled "Planned Seeing" has been issued by the Air Ministry (Air Publication 3139B). It is a report by Sir Frederic Bartlett and Dr. N. H. Mackworth, respectively Director and Assistant Director of the Medical Research Council's Applied Psychology Research Unit at the University of Cambridge. It deals with some war-time experiments to ascertain the conditions necessary for good visibility in Fighter Command Control Rooms, and to aid in planning the training of Pathfinder Air Bombers in Visual Centring on Target Indicators. In their conclusions on the requirements for control rooms, the authors stress the importance of size as a factor affecting the visibility of the objects the controller must see. Since the actual dimensions of plotting arrows, letters and numerals cannot conveniently be large, adequate apparent size must be secured by design for a short viewing distance between controller and display. Also, "to ensure an easily seen display, many obvious points, such as good lighting without glare, have to be considered. A factor which has been greatly overlooked is the benefit likely to be obtained from making sure that the brightness contrast of the object and its background is well marked. . . . The actual colour contrast is far less important for visibility than the brightness contrast. The difference between the amount of light reflected by the object and by its background may make all the difference between the right and the wrong answers at critical levels of seeing, particularly if the actual object is small or has to be seen obliquely from some considerable distance."

These factors, size and brightness contrast, are, of course, the primary ones in the I.E.S. Code method of appraising visual tasks for the purpose of prescribing sufficient illumination. In the experiments described in Planned Seeing, equally good results were obtained with blue objects on a yellow background as with red objects on a yellow background. These are very different colour contrasts, but they are both good brightness contrasts. Bartlett and Mackworth's experiments were done with good fluorescent lighting. They found that design improvements in the contrast and shape of the lettering, with which some of their experiments were concerned, were of greater benefit to those with ordinary than to those with exceptional eyesight; just as Weston has shown that the benefit resulting from a given increase of illumination is greater in those with old than in those with young eyes, and, as Hopkinson has shown, is greater in those with sub-normal than in those with normal vision. Planned Seeing affords a good example of what can be done to improve human performance by establishing better seeing conditions when, by the analysis of visual tasks, the best or the most practicable lines of improvement are indicated.